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with which mankind is concerned, and that the energy which supplies the world to-day is being derived largely from a rapidly diminishing supply of fuel stored up in the past, it is evident that atomic structure is one of the most fundamental problems with which science is concerned.

I know it would be presumptive to assume that we shall sometimes be able to utilize the energy which is stored up in the atom, and, on the other hand, it would be equally presumptive to assume that the atom is the barrier beyond which science can not go. The history of science contains numerous examples of these barriers which have been placed by scientists themselves, and which in many cases have fallen before the conquest of these same scientists. Maxwell said the "atom is incapable of growth or decay, of generation or destruction." We now know that certain atoms are disintegrating, and new atoms forming continually. Less than a century ago scientists assumed that a "vital force" was essential in the formation of organic compounds. To-day thousands of such compounds are being synthesized in the laboratory, and many useful products are being made which, so far as known, the "vital force" has never produced. When Hertz succeeded in producing electromagnetic waves which are now the basis of wireless telegraphy and telephony, he thought it would be impossible to make use of such waves to transmit signals to any great distance. And so on, the unknown and apparently the unknowable of one generation may become the commonplace knowledge of the next. We do not know to what extent we shall be able to solve the mysteries of the atom, and we are unable to even predict the consequences of such a discovery. We know that the problem is beset with almost insurmountable difficulties, and that our knowledge on the subject can never reach finality.

The interior of the atom is the common ground where chemistry and physics meet, and there is probably no problem before the scientific world to-day that offers greater difficulty or promises greater reward than that of determining the nature and arrangement of the constituents of the atom, and the laws which govern their motion. The discoveries already made in this direction have broadened the range of scientific research, and advanced our knowledge one step farther into the mysteries of nature; and it is largely the mastery of man over the laws of nature which marks the progress of the world.

WILLETT L. HARDIN

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ON THE UTILITY OF FIELD LABELS IN HERBARIUM PRACTISE

ROUTINE technique in ordinary herbarium practise has made little advance for many years, in sharp contrast to the highly specialized technique in most other fields of botanical work. It is true that no revolutionary changes are to be expected in herbarium methods, yet the author is convinced that some changes are urgently needed in order that the great herbaria now so rapidly being built up in this and in other countries shall be more generally useful than they are to-day.

It is perhaps a survival of the Linnean idea that the name of the plant was the important thing to record on the specimen, and that all other data were secondary, that is reflected in modern herbarium practise. We have advanced, however, to the point where it is conceded by all botanists that the conventional data, geographic locality, collector and date of collection must be added to each specimen, yet many botanists and collectors do not realize the vital necessity of recording in a form that will be available to other workers essential data regarding the plant itself. The result is that the chief value of most large herbaria, aside from supplying material by which the limits of variation may be determined, or the limits of species decided, and in

supplying material on which the descriptions of new species may be based, is in determining the geographic distribution of various species, their dates of flowering and fruiting, and their collectors. What a relatively small return for the time, labor and money expended in building up any large herbarium! Perhaps the average curator is too conservative, yet conservatism carried to the point of not adding any data to the average mounted herbarium specimen other than the conventional Latin name, geographic locality, collector and date of collection of the plant, is absurd. Yet any one who has had long experience in most herbaria will fully realize that collection after collection received with data in some form about the specimens themselves, is often eventually distributed into the herbarium with most or all of the special data eliminated or at least very greatly abbreviated.

Perhaps the weakest point in all large herbaria is the lack of special data with the mounted specimens. The average herbarium, no matter how large or where located, will yield comparatively little information about the plants themselves other than the data that can be determined from the dried specimens and the conventional data usually recorded. As to the individual species, habit, habitat, altitudinal range, size, except for small plants, relative abundance, odor when fresh, color and odor of the flowers, special characters of the fruits not shown by dried specimens, the presence or absence of milky juice, gums or resins, vernacular names, economic uses, etc., can not be determined from a very high percentage of all extant herbarium material, chiefly because the data covering these points are not recorded by the average collector or botanist, or if recorded are not attached to the mounted herbarium specimen in average herbarium practise.

No botanist, from field work, can intimately learn the special characters of more than a few thousand species of plants, and unless he records special data in some form, he will frequently find his memory at fault regarding this or that character of this or that species. The average herbarium will give him little or

no assistance, as so few specimens present any special data regarding the plants themselves. This fault in current herbarium practise is apparently reflected in some of our modern manuals, where, for some species, the size of the plant is not given at all, or is inaccurately given, the color of the flowers ignored, and other data that would be of distinct value to the field botanist, are frequently wanting. It is very probable that many of the vernacular names cited in our manual, are not now in use in the United States except as they are learned from the manuals themselves, that is, book names, and undoubtedly hundreds of vernacular names in more or less common use are unrecorded. Scores of "common names" have no existence except in print, being often merely a translation of the Latin name. How much better it would be to cite an actually used vernacular name, even if known only in a limited region, than to coin a common name by the simple process of translating the Latin one, and thus establishing in print a name that nobody ever uses. Yet probably no herbarium in the United States gives any appreciable amount of data as to vernacular names actually in use for the simple reason that botanists and collectors have neglected to record such names with the specimens.

A herbarium to be of the greatest service should present not only the geographic range of the various species, their period of flowering and fruiting, and when and by whom collected, but also the essential data regarding the individual plants themselves indicated above. In other words a properly prepared herbarium should be a card index to the various aspects of the species represented by dried specimens, their economic uses, vernacular names, and all possible information regarding the individual plants themselves that the dried specimens and usually recorded conventional data do not show.

The local botanist or collector may, and often does, record copious notes in various types of notebooks, but usually such notes are available only to himself, never become actually attached to his herbarium specimens, and ultimately become lost. If the collector does

not attach his notes to his specimens it can hardly be hoped that some other person will do it for him.

Those herbaria that are rich in original collections should present the most data regarding the plants themselves, yet very little attention is given to the eminently practicable and logical procedure of recording notes with the specimens in most herbaria. In almost any large herbarium case after case could be cited where original data regarding the plants themselves recorded on the specimen sheets, on slips of paper, or in notebooks, have deliberately been discarded either because it was not recognized herbarium practise to record such data, or at least to attach the data to the herbarium specimen; because the ultimate value of such data was not realized; because there is no generally recognized place on herbarium sheets for recording miscellaneous data; or perhaps more often because of the time involved in copying data from crude field notes. This brings up a vital phase of the subject, and that is, even if the original data be carefully copied on the herbarium sheet, the *original notes*, no matter how crude, should always be attached to the sheet as a part of the record.

Perhaps one potent reason why in ordinary herbarium practise little special data is recorded with the specimen is that the average herbarium label is too small on which to record more than a small fraction of the data that might or should be recorded with the specimen. In the opinion of the author the conventional herbarium label is no place on which to record other than the data for which it was designed, the name, locality, collector and date of collection. For esthetic reasons many botanists are opposed to writing on the herbarium sheet, and aside from the herbarium label itself, there is no recognized place on the sheet for recording special data. The question of time and labor is also involved, for under common practise special data must be copied from a notebook or compiled from memory. The problem of recording data with the mounted specimen with the least possible loss of time and labor, is solved by the adoption of a field label.

The urgent need of some radical change in current American herbarium practise is not fully realized, and in the matter of recording special data on mounted botanical specimens American institutions are, on the average, about the same as those of other countries. Fifteen years' work in systematic botany in many different herbaria in the United States, in Europe, in Asia and in Malaya, and my own experience in establishing and building up the herbarium of the Bureau of Science in Manila, has led me to prepare the present paper with the hope that it may lead to a higher average of herbarium practise as to the recording of data about the individual species. To give some definite idea of the great lack of special information about the plants themselves, as recorded in the average herbarium, I have compiled data from 3,000 mounted herbarium specimens, taken at random from three types of herbaria. Care was taken in each case, however, so to select the sheets that families presenting trees, shrubs, vines and herbs were included. In one case not less than 75 per cent., and in two cases over 90 per cent. of the sheets represented the original specimens, that is, the first set, whenever duplicates were prepared, and material primarily collected for the institutions to which the herbaria belong. In not a single case did the special data record on any specimen exceed fifteen words on the 3,000 sheets examined, the average certainly not exceeding five words. In separating the specimens into two categories, one with special data and one without, if a single word such as "tree," "forests," "swamp," etc., was added beside the conventional Latin name, locality, collector and date of collection, the specimen was placed in the group with special data.

In a large collection assembled over the course of more than forty years, the combined results of the field work of many botanists and collectors for the purpose of working up a local flora, of 1,000 sheets examined less than 10 per cent. presented any data regarding the plants themselves. Over 90 per cent. presented merely the conventional data, Latin name, locality and date of collection, collector; not a word regarding even the size, habitat or

special characters of the plant or its parts. The botanist who utilizes this large collection for the purpose of writing a local flora must himself go into the field and to a large degree determine anew the special data that should have been accumulating during the past forty years regarding the special characters of each individual species found in the area covered by the collection. To-day nobody can determine what original notes were made by the various collectors, and unquestionably observations or notes were made when most or all of the specimens were actually collected.

In a much larger collection of exotic plants, a collection still apparently rich in species as yet undescribed, and a collection in which at least 75 per cent. of the sheets represent *original* collections, less than 8 per cent. of the sheets bear any data whatever other than the conventional Latin name (so far as the material is identified), collector, locality and date of collection.

In a third collection, a herbarium of economic plants, presenting chiefly those species actually cultivated for agricultural or horticultural purposes, on a basis of 1,000 sheets examined, less than 3 per cent. of the sheets present any data regarding the plants themselves. It is estimated that at least 95 per cent. of this herbarium represents *original* collections.

In contrast to the above three herbaria I wish to cite the one in which I am especially interested, the contrast of which has led me to prepare this paper, and that is the herbarium of the Bureau of Science in Manila. In this herbarium there are now approximately 160,000 mounted sheets, of which about 100,000 are Philippine, the remainder chiefly from surrounding regions. The extra-Philippine material, except that collected by employees of the Bureau of Science, as to special data recorded with the specimens, is quite like similar material received in exchange by other institutions. Taking into consideration only the Philippine material, approximately 75,000 sheets, or 75 per cent. of this part of the herbarium, present special data regarding the plants themselves recorded on field labels of one type or another. These field labels were

filled out when the plants were collected, were placed with the specimens in press, remained with the specimens through all processes until the mounted sheet was distributed into the herbarium, and the accumulated data thus recorded has added immensely to the value of the herbarium. The notes with the specimens represent the combined field observations of perhaps 100 different American and Filipino collectors, and the botanist working with this material has at once available a great mass of information that is not to be found at all in the average herbarium, and information that no single collector could possibly secure in any reasonable time. The herbarium is what it ought to be, an index to the various aspects of Philippine botany from both an economic and a scientific standpoint. It is consulted not only by systematic botanists, but also by foresters, agriculturists, horticulturists, philologists and others interested in the economic aspects of botany.

In a very few European herbaria field labels have been used for a number of years, but in general their great utility has been quite overlooked by botanists, collectors and curators of herbaria, and in most herbaria are quite unknown. Every European field label I have seen presents what I consider to be serious defects either in form, in size or in indicated data to be recorded. From my early work in the United States Department of Agriculture I was familiar with the types of labels used for field work in the Division of Agrostology, which were sometimes attached to the mounted sheets, and sometimes not; these labels had a fatal defect in that the attempt was made to combine a field label with a herbarium label, and their use was eventually abandoned. In establishing the botanical work in the Philippines in the year 1902 I was immediately impressed with the necessity of recording data about the plants themselves in such form that it could be recorded with the mounted specimens. The first field label adopted was exceedingly crude and experience on a single field trip proved that it was utterly unadapted to the purpose in view. In the meantime, however, I became acquainted with the forms de-

veloped by Dr. S. H. Koorders for his field work on the forest flora of Java,¹ and a modified form of the smaller type of label used by him was adopted for use in the Philippines early in the year 1903. From

adapted to a special purpose, that is, the botanical exploration of Amboina with special reference to data that is essential in interpreting the species figured and described by Rumphius in his "Herbarium Amboinense."

FLORA OF THE PHILIPPINE ISLANDS

HERBARIUM, BUREAU OF SCIENCE

Common name Dialect
 Field No. Herbarium No.
 Collector
 Island of Province
 Locality
 Habitat

 Altitude above the sea meters
 Tree; shrub, bush; vine; herb
 Height of plant M.
 Diameter of plant, breast high Cm.
 Flower
 (Odor, color, etc.)

 Fruit
 (Kind, odor, color, etc.)
 Special notes

 Economic uses

 Date

FIG. 1. A FIELD LABEL FOR GENERAL PURPOSES.
Actual size 15.5 × 8.5 cm.

time to time changes were made in the arrangement of the printed data on the label, as the field experience of myself and associates seemed to warrant, until the label finally assumed the form presented in Fig. 1, in actual size 15.5 by 8.5 centimeters. Fig. 2 represents a somewhat modified form of the label as

¹ Merrill, E. D., "Report on Investigations Made in Java in the Year 1902," Philip. Forestry Bureau Bull., 1: 60-63, 1903.

FLORA OF THE MALAY ARCHIPELAGO

HERBARIUM, BUREAU OF SCIENCE, MANILA, P. I.

Common name Dialect
 Field No. Herbarium No.
 Collector, C. B. Robinson
 Island
 Locality
 Habitat
 Altitude above the sea M.
 Tree; shrub; woody vine; herbaceous vine; herb ..

 Height of plant m.; diameter cm.
 Flower

 Fruit
 Supposed to represent

 Rumph. Herb. Amb.

 Identification considered certain; probable; possible; very doubtful.
 Date, 19

FIG. 2. A FIELD LABEL FOR A SPECIAL PURPOSE.
Actual size 15.5 × 8.5 cm.

The field label as developed for the botanical work in the Philippines is presented not with the idea that it presents, as to printed form and data, the label that is best for general use in other countries, but merely the label that twelve years' experience has shown to be best adapted to our purposes in the Philippines. It is doubtful, however, if the shape and size could be improved upon, but the printed data could be modified to suit the country in which collections are to be made, or to suit the pur-

poses of the collector if he confines his field work to special groups of plants. A label, if made too small, will interfere with the proper handling of mounted herbarium specimens if it is attached where it should be placed, that is, at the *upper left-hand corner* of the herbarium sheet. If made too large and complex too much time is involved in properly filling it out. The label now used in the Philippines assumed its present form largely because much of the field work of necessity must be carried on by men with little botanical training. To an inexperienced collector, then, a field label serves as an indicator as to the data that is of the most value, and the data that should be recorded in order that the specimen when finally mounted, shall present as many facts as possible about the plant that are not shown by the dried specimen itself.

I know of no serious objection to the use of field labels, and by their use an enormous mass of most valuable information can be recorded in such form that it will be available to other botanists than the collector, data that is not now being recorded at all, or if recorded is, except in special cases, never attached to the mounted herbarium sheets. From long personal experience with field labels, and judging from the experience of many others who have used them in the Philippines, it is confidently prophesied that the average collector or botanist who adopts a logical compact form for recording his notes on field labels, and who once fully appreciates the advantages and simplicity of the system, will never revert to the now almost universal and decidedly impracticable method of recording notes on the specimen sheets or in a notebook.

Objections that have been offered to the use of field labels are not especially valid. In practise the size adopted in the Philippines will not be found to be too great; it is approximately the size of generally used pocket notebooks; it takes up little space on the mounted sheet, and if properly placed does not in the least obscure the mounted specimen, or interfere with the handling of the herbarium sheets. Scanty or copious notes may be taken at the discretion of the collector. A specially

modified form may be adopted for special groups of plants, such as ferns, lichens, fungi, grasses, etc., or for special types of herbaria, such as dendrological collections, agricultural or horticultural plants, etc. The field label is not too complex, and the printed form can be filled out much more rapidly than can a similar amount of data be recorded on a blank page. Under all but the most abnormal field conditions the label can readily be filled out when the plant is collected, or soon after the specimens are placed in press and before the collector's conception of the plant has become dim. To the objection that the labels can not properly be filled out when one is heated and perspiring from field work, I can merely point to the 40,000 specimens in the Javan collections of Koorders, and nearly twice this number in the Philippine herbarium, all of which were filled out in the field in tropical and not in temperate regions, and often under the most adverse climatic conditions.

If it is considered desirable the labels can be numbered serially before commencing field work, thus avoiding the danger of duplicating or of skipping numbers. In all cases, however, the field label should be placed with the specimen it describes in press, and should remain with the specimen under all circumstances and through all processes until the mounted sheet is distributed into the herbarium. In practise it has been found much more convenient to have the labels perforated at the top, that they may readily be removed, and bound into notebook form, 100 labels to a book. It sometimes happens that it is desirable that the collector retain his notes in serial form. This is very readily accomplished by utilizing a carbon paper and making two copies of the label, one to be removed from the book and placed with the specimen, one to be retained in the book in its serial place; the original label may be white, and the duplicate on pink or yellow paper.

The proper place for the field label on the mounted herbarium sheet is in the *upper left-hand corner*. Here it interferes less with the mounted specimen than in any other position and causes the least trouble in handling the

mounted sheets. It should be attached merely by gumming the lower surface of the upper left-hand corner of the label, and under no circumstances should the entire back of the label be pasted to the sheet. It frequently happens that it is necessary or desirable to record additional data on the back of the label, and again, if merely attached by the upper left-hand corner, the label can then be lifted or turned back should it cover any portion of the specimen that it is necessary or desirable to examine.

The advantages of a comprehensive system of field labels are very great, and their use should appeal to the most conservative botanist. The addition of the field label to the mounted sheet does not detract from the appearance of the mounted specimen, it supplies a proper place for recording data regarding the plant itself that otherwise, if recorded at all, must be abbreviated and crowded on the small herbarium label or laboriously copied on the sheet itself, and if consistently used will preserve in a form available for other contemporary workers as well as for future botanists a mass of information regarding the plants that is now not being recorded at all, or if recorded, is rarely attached to the actual mounted specimens and ultimately becomes lost.

E. D. MERRILL

BUREAU OF SCIENCE,
MANILA, P. I.

NATIONAL ACADEMY OF SCIENCES

THE autumn meeting of the National Academy of Sciences will be held on Monday, Tuesday and Wednesday, November 13, 14 and 15, 1916, in the new buildings of the Massachusetts Institute of Technology, adjoining the Charles River Basin in Cambridge, with headquarters across the Basin at the Harvard Club, 374 Commonwealth Avenue, in the Back Bay district of Boston. Hotels Puritan and Somerset, in the same block with the Harvard Club on Commonwealth Avenue, will be convenient for members accompanied by their families. Luncheon will be provided for members and ladies accompanying them at Riverbank Court, adjoining the Institute buildings

on Monday and Tuesday, and at several of the neighboring scientific institutions on Wednesday.

It has been found necessary to postpone the William Ellery Hale lectures, previously announced to be given by Professor E. G. Conklin on Monday evening and Tuesday afternoon, November 13 and 14. The Monday evening lecture will be replaced by an introductory address by President W. H. Welch on the Formation of the National Research Council at the request of the President of the United States and a lecture by Dr. S. W. Stratton, director of the National Bureau of Standards, on the Target Practise in the Navy and some of the Research Problems involved, illustrated with moving pictures. The Tuesday afternoon session will be devoted to reports by members of the National Research Council.

At the close of the Monday evening session a reception will be held by President and Mrs. Maclaurin of the Massachusetts Institute of Technology and President and Mrs. Lowell of Harvard University, in the General Library where a scientific exhibit will be displayed. On Wednesday there will be visits to scientific institutions in and near Boston.

The local committee consists of W. M. Davis, chairman, W. T. Councilman, A. A. Noyes and E. C. Pickering.

The program of papers to be read at the meeting is as follows:

Monday, November 13

From 2.00 to 3.30:

Welcome by President Maclaurin, of the Massachusetts Institute of Technology.

Raymond Pearl, Maine Agricultural Experiment Station. Some Effects of the Continued Administration of Alcohol to the Domestic Fowl, with special Reference to the Progeny. (20 minutes, lantern.)

Edward S. Morse, Salem, Mass. Protoconch of *Solemya*. (10 minutes.)

Alfred G. Mayer, Marine Laboratory, Carnegie Institution. Further Studies of Nerve Conduction. (10 minutes, lantern.)

E. G. Conklin, Princeton University. The Share of Egg and Sperm in Heredity. (10 minutes, lantern.)